DØ Instantaneous Luminosity
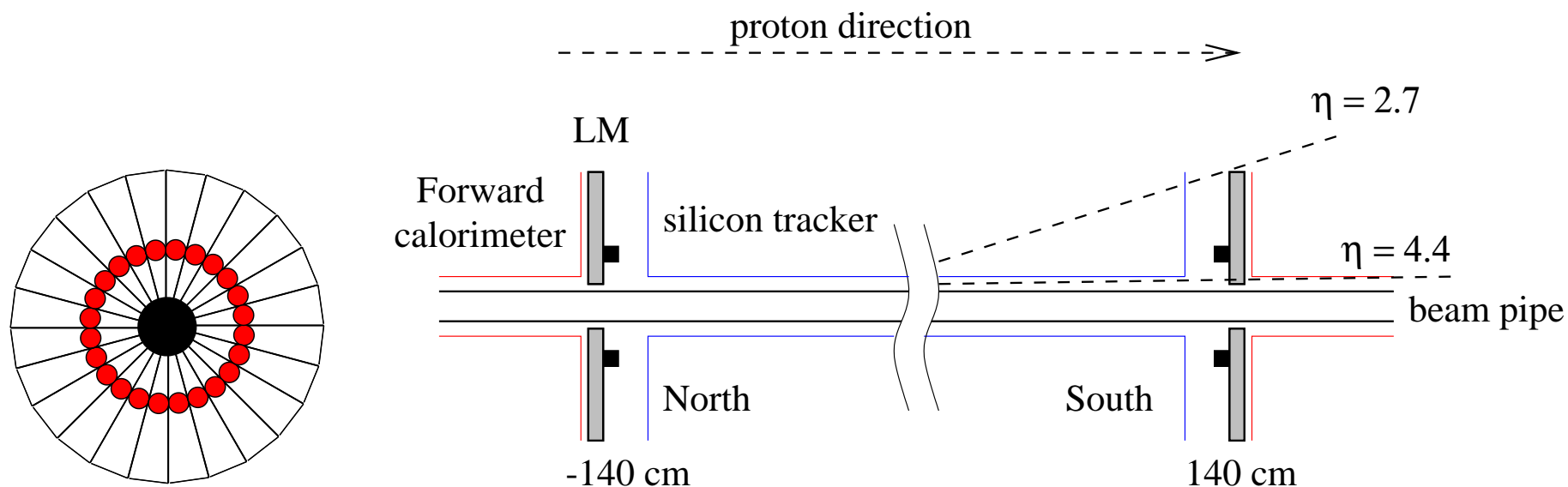
Brendan Casey

March 21, 2005
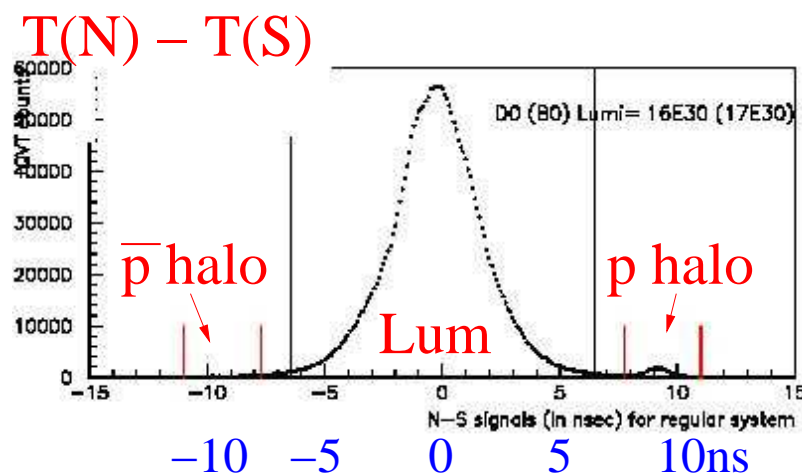
- Overview

- Baseline shift
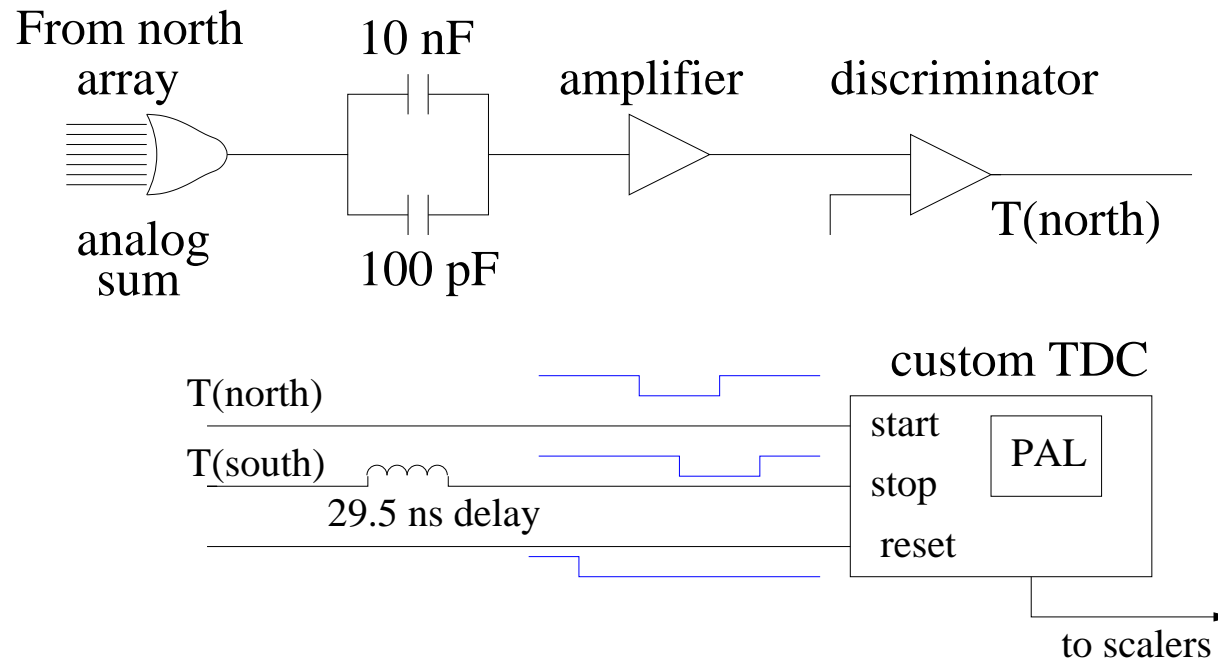
- Deadtime

DØ Luminosity Measurement

Inelastic collisions identified by coincidence in north and south scintillator arrays.

Timing info used to separate inelastic collisions from beam halo.

Detector Readout

PMT signals summed then discriminated → one timing signal each for north and south.

AC coupled after sum to remove any time dependent baseline shifts on detector and in summers
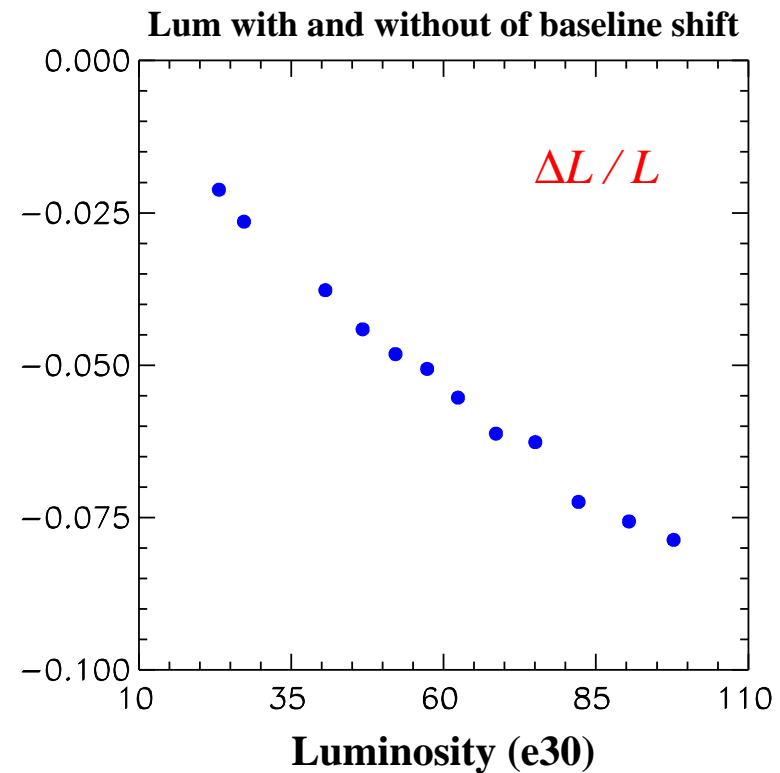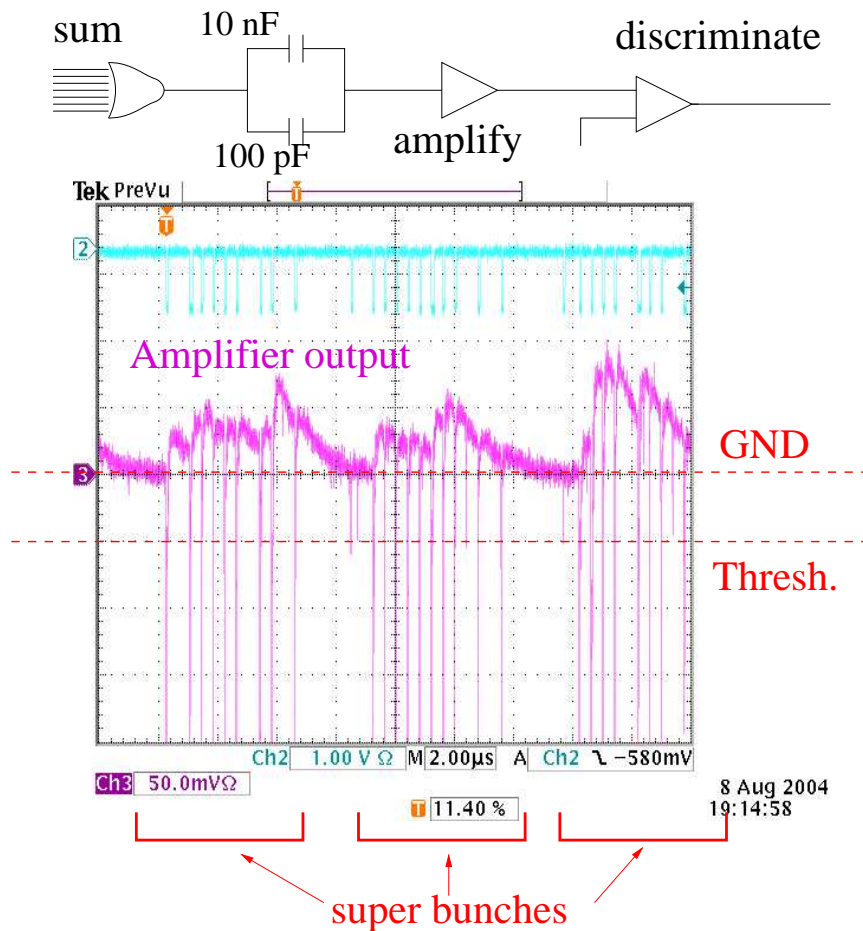
Fed into custom TDC: north = start, south = stop.

LUT in PAL to identify valid time differences.

Baseline Shift

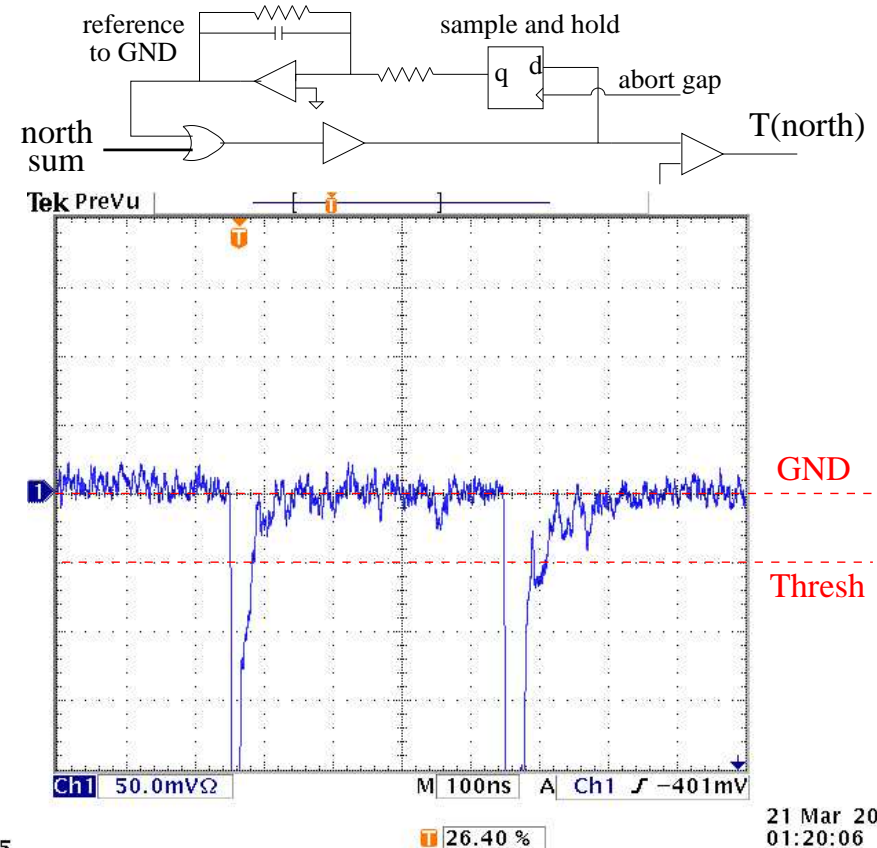Became aware of baseline shift in Aug 2004. τ for AC coupling too long.

sum   10 nF   discriminate
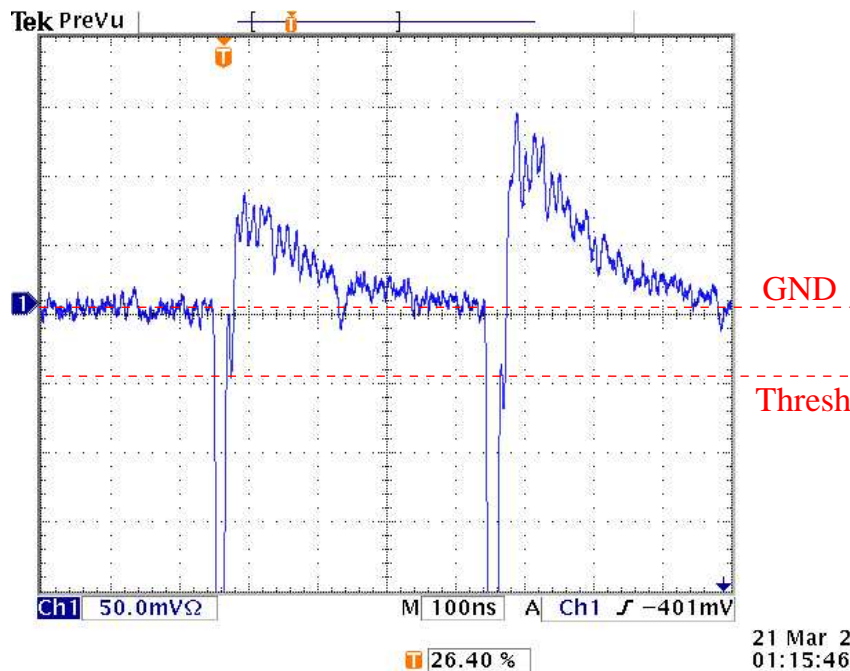
amplify

100 pF

Amplifier output

GND

Thresh.

super bunches

Lum with and without of baseline shift

$\Delta L / L$

Luminosity (e30)
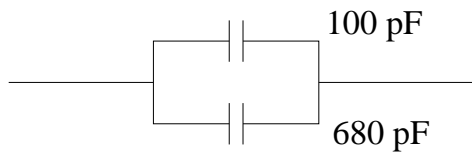
$(L[\text{10nF}]\text{-}L[\text{0.68nF}])/L[\text{0.68nF}]$
(both including deadtime
correction)
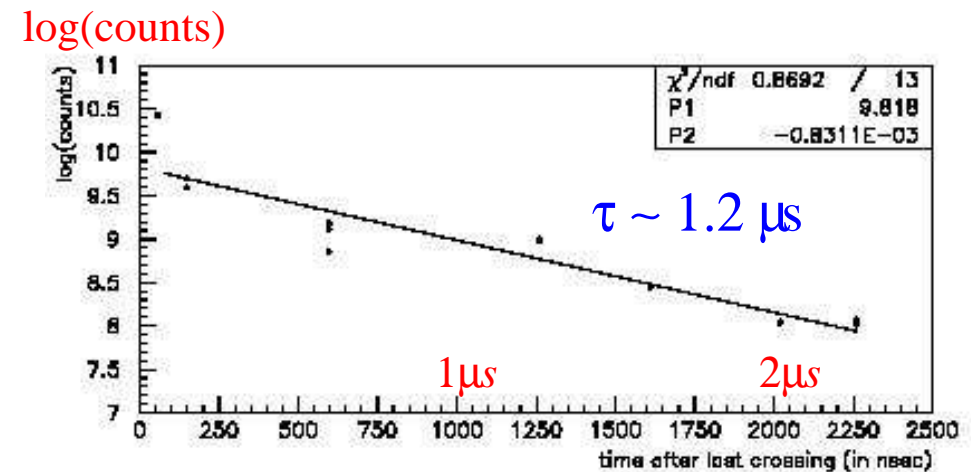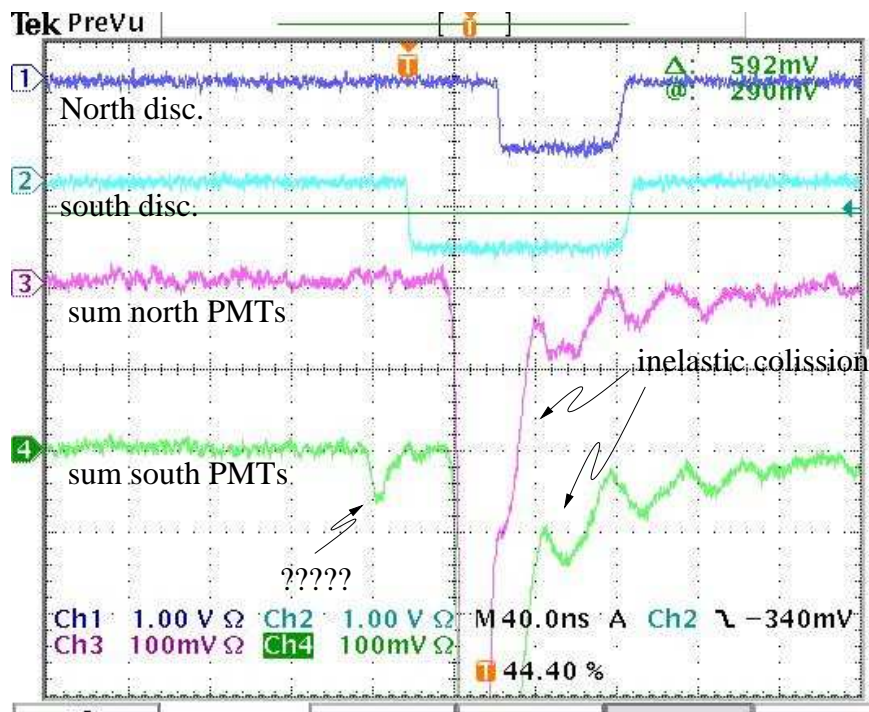
Removing the Baseline Shift

Use either smaller blocking capacitor or DC coupling with active baseline restoration to address impact of baseline shift.

Deadtime

Early hits trigger the start or stop on the TDC $\Rightarrow$ readout is off until next reset. Corrections already in place for backgrounds in-time with bunches (halo).

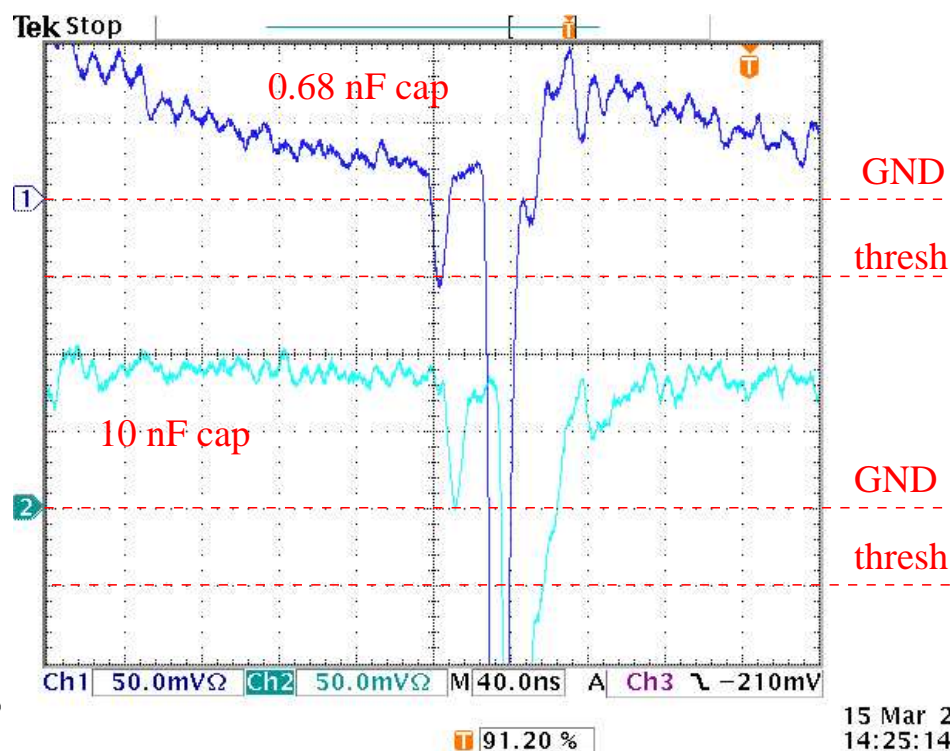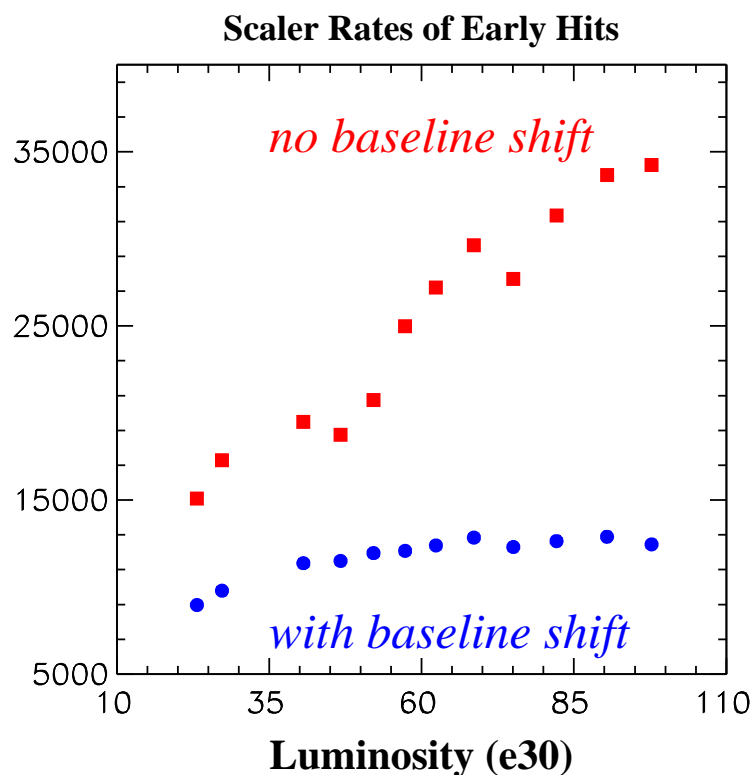Additional background observed in January 2005. Luminosity dependent but not in time with bunches. Most likely due primarily to detector activation.

Baseline Shift and Deadtime

Drastic increase in sensitivity to additional background once baseline shift removed.

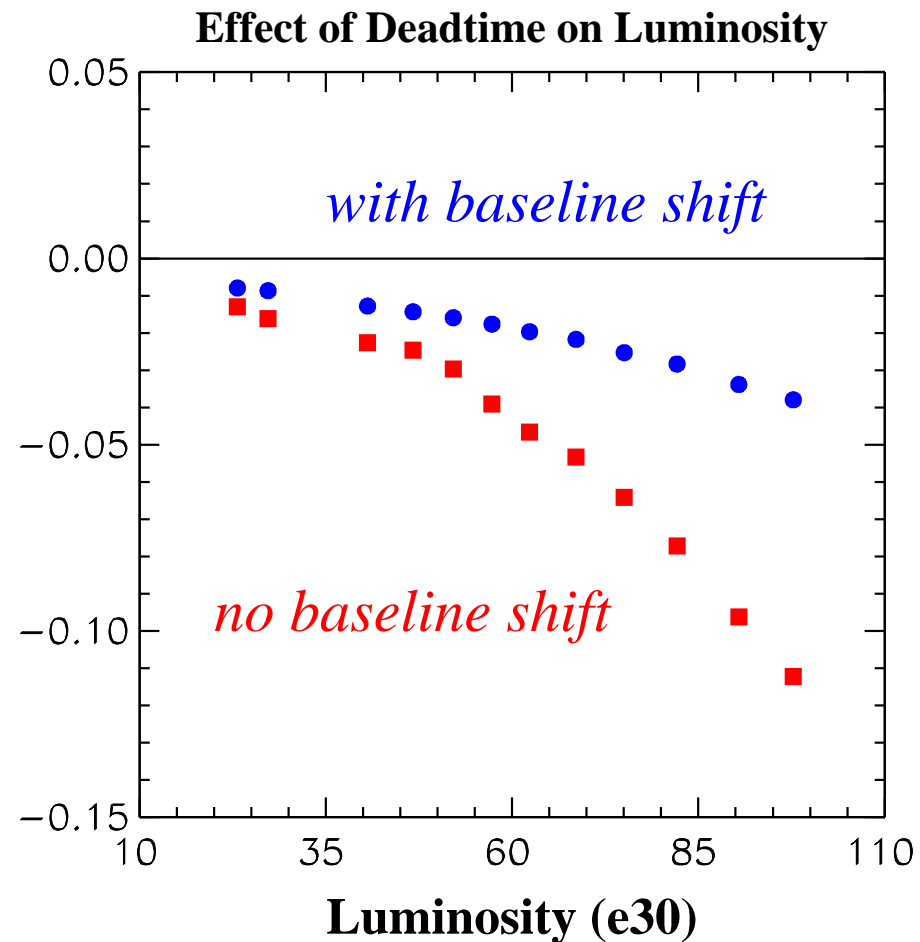# Deadtime and Luminosity

$(L[\text{raw}]\text{-}L[\text{w/ deadtime correction}])/L[\text{w/ correction}]$

Effect of Deadtime on Luminosity

circles: effect of deadtime on $L[10\text{nF}]$

squares: effect of deadtime on $L[0.68\text{nF}]$

with baseline shift

no baseline shift

Luminosity (e30)

Deadtime: linear effect on scaler rate $\rightarrow$ nonlinear effect on luminosity.

New Deadtime Correction

- First minimize deadtime:
  - reduce discriminator widths
  - delay reset: assert just before next collision

- measure deadtime online:
  - count crossings where both discriminators fire and one is not in time.
    * these are ambiguous crossings where we can not rule out the presence of an inelastic collision.

- correct the scaler rates for the deadtime online. (Same as previous correction for backgrounds from halo.)

Conclusions

- Additional deadtime correction put online March 17, 2005

- Also switched from AC coupling with short time constant to DC coupling with active baseline restoration.

- These changes introduce a small shift in the overall luminosity scale at low luminosities.

- In the process of re-evaluating absolute efficiency of detector to account for new coupling scheme, additional deadtime correction, and new DØ solenoid magnetic field value.